

REMARKS/ARGUMENTS

The Final Office Action dated December 7, 2009 ("Office Action"), has been received and carefully considered. In this response, claims 1-9 have been amended and claim 21 has been added. No new matter has been added. Entry of the amendments to claims 1-9 and the addition of claim 21 is respectfully requested. Reconsideration of the outstanding objection/rejections in the present application is also respectfully requested based on the following remarks.

I. THE OBJECTION TO CLAIMS 1-9

On page 3 of the Office Action, claims 1-9 were objected because of minor informalities. Regarding claims 1-9, Applicant has amended claims 1-9 and thus renders the aforementioned objection moot. Accordingly, Applicant respectfully requests that the Examiner withdraw the objection to claims 1-9.

II. THE INDEFINITENESS REJECTION OF CLAIMS 1-9

On page 5 of the Office Action, claims 1-9 were rejected under 35 U.S.C. § 112, second paragraph, as being indefinite for failing to particularly point out and distinctly claim the invention.

Regarding claims 1-9, Applicant has amended claims 1-9 to more particularly point out the claimed inventions and thus render the aforementioned rejection moot. Applicant has taken suggestions by the Examiner into account to amend claims 1-9. In particular, Applicant submits that the "wafer" has been defined as a "processed semiconductor wafer" throughout the claims. Applicant submits that in line 2 of claim 1, the general term "a stack of wafers" is used because the stack of wafers can comprise "processed semiconductor wafers" as well as other wafers, for example glass substrates.

Regarding claim 9, Applicant submits that current amendments further define a “SOI wafer.” Specifically, claim 9 as currently amended, recites a SOI wafer “comprising an active semiconductor layer and a buried oxide layer on a substrate.” Therefore, Applicant submits that claim 9 particularly points and distinctly claims the subject matter which Applicant regards as the invention.

Accordingly, Applicant respectfully requests that the aforementioned indefiniteness rejection of claims 1-9 be withdrawn.

III. THE OBVIOUSNESS REJECTION OF CLAIMS 1-8

On page 7 of the Office Action, claims 1-8 were rejected under 35 U.S.C. § 103(a) as being unpatentable over U.S. Patent No. 6,555,414 to Vanfleteren *et al.* (“Vanfleteren”) in view of U.S. Patent Application Publication No. 2004/0142540 to Kellar *et al.* (“Kellar”). This rejection is hereby respectfully traversed.

Under 35 U.S.C. § 103, the Patent Office bears the burden of establishing a *prima facie* case of obviousness. In re Fine, 837 F.2d 1071, 1074 (Fed. Cir. 1988). There are four separate factual inquiries to consider in making an obviousness determination: (1) the scope and content of the prior art; (2) the level of ordinary skill in the field of the invention; (3) the differences between the claimed invention and the prior art; and (4) the existence of any objective evidence, or “secondary considerations,” of non-obviousness. Graham v. John Deere Co., 383 U.S. 1, 17-18 (1966); see also KSR Int’l Co. v. Teleflex Inc., 127 S. Ct. 1727 (2007). An “expansive and flexible approach” should be applied when determining obviousness based on a combination of prior art references. KSR, 127 S. Ct. at 1739. However, a claimed invention combining multiple known elements is not rendered obvious simply because each element was known independently in the prior art. Id. at 1741. Rather, there must still be some “reason that would have prompted”

a person of ordinary skill in the art to combine the elements in the specific way that he or she did. Id.; In re Icon Health & Fitness, Inc., 496 F.3d 1374, 1380 (Fed. Cir. 2007). Also, modification of a prior art reference may be obvious only if there exists a reason that would have prompted a person of ordinary skill to make the change. KSR, 127 S. Ct. at 1740-41.

Regarding claim 1, the Office Action asserts that the claimed inventions would have been obvious in view of Vanfleteren and Kellar. Applicant respectfully disagrees. Applicant submits that Vanfleteren discloses in Figures 4A to 4F, an assembly process for flip-chip mounting of devices to a substrate comprising the steps of: providing a substrate 3 comprising a plurality of metal areas called bonding or contact pads 2a and the chip 1, equally comprising a plurality of metal areas (2b) corresponding to said bonding pads (2a) on the substrate. The component's bonding pads (2b) can be chip bumps or pins, Step I1 (FIG. 4A). The assembly process also comprises application of the ICA 6 on bonding pads 2a present on the substrate 3, Step I2 (FIG. 4B). Step I3: Drying of the ICA. Step I4 (FIG. 4C: cross section, FIG. 4D: top view): Application of NCA underfill material 5 to the substrate 3 in between the bonding pads 2a. Step I5 (FIG. 4E): Alignment and placement of the component 1. Step I6 (FIG. 4F): Execution of a thermo compression step to create electrical contacts between the component 1 and the substrate 3. *See, e.g.*, column 6, lines 35-56.

Applicant respectfully submits that the underfill material 5 as taught by Vanfleteren, is a non-conductive adhesive (NCA) and the bonding material 6 is an isotropic-conducting adhesive (ICA). Therefore, the underfill material 5 as well as the bonding material 6 are **adhesives**, and such adhesives are epoxy adhesives or acrylic and polyamide type adhesives. *See, e.g.*, column 7, lines 63-65. Thus, Applicant respectfully submits that the underfill material 5 and the bonding material 6 cannot be interpreted as the recited “electrically non-conducting **glass paste**” and the “electrically conducting **glass paste**,” respectively, as alleged on page 8 of the Office Action.

In addition, the Office Action relies on Vanfleteren's disclosure of a "glass temperature" in column 8, line 29, to conclude that the materials used for the structured layers in Vanfleteren are glass pastes. Applicant respectfully disagrees. Applicant respectfully submits that according to the article titled "Glass Transition Temperature" in "PlasticsWiki", Free Encyclopaedia, the "glass transition temperature of a material is the temperature below which molecules have little relative mobility." The term "glass temperature" is not only used for glass materials but for plastic materials, as can be seen in the section "Glass Transition Temperature of some Materials" of the above mentioned article. Also, according to the article "Glass Transition Temperature," polypropylene and polyesterene (plastics materials) have a glass transition temperature of 100°C and that fluoroaluminate (glass material) has a glass transition temperature of 400°C. In fact, Vanfleteren discloses that the material used for the electrically non-conducting material 5 is a non-conductive adhesive (NCA). *See, e.g.*, column 2, line 11 and column 8, lines 55-57. Moreover, Vanfleteren discloses that the electrically conductive material 6 is classified as isotropic conductive adhesive (ICA), where the ICA is epoxy adhesive having a curing temperature of 120 to 150°C. *See, e.g.*, column 2, line 10 and column 7, lines 50-65.

Therefore, Applicant respectfully submits that Vanfleteren, at most, discloses that the electrically non-conductive material 5 and the electrically conductive material 6 are plastic materials. Also, the plastic materials are normally applied during a "drying" process and a "curing" process, instead of during the processing conditions and temperatures from "conditioning" and "pre-treating" of glass pastes, as recited in claim 1. Applicant respectfully submits that the glass pastes used in the present inventions and the plastic materials used in Vanfleteren, have totally different properties. Also, the "conditioning and premelting of the electrically non-conducting glass paste and the electrically conducting glass paste," as recited in claim 1, are not comparable to the drying and curing steps in connection with plastic materials.

Therefore, the conditioning and pre-melting steps as recited in claim 1 are simply different from the drying and curing processes of Vanfleteren.

Furthermore, the wafers of Vanfleteren are not joined at the processing temperature of glass pastes. In particular, according to an exemplary embodiment of the processing temperature for the glass pastes in the present application is, for example, 450°C, while Vanfleteren discloses a drying temperature at 100°C. Thus, it is clear that the adhesive materials of Vanfleteren cannot be glass pastes because the materials of Vanfleteren cannot withstand the processing temperature of glass pastes, i.e. 450°C.

Additionally, it should be noted that the sequence in applying the insulating and conducting patterns disclosed by Vanfleteren, is different from the sequence of applying the insulating and conducting patterns according to the claimed inventions. Applicant submits that Vanfleteren discloses that the insulating material may be added after the electrical connections have been finished. With the glass paste as used, as recited in the claimed invention, it is not possible to add the glass paste after the electrical connections have been finished. This difference also reflects the fundamental difference in the technology of the state of the art and the claimed invention.

The Office Action alleges that Kellar discloses bonding together multiple semiconducting wafers with a bonding adhesive such as borophosphosilicate glass. Also, the Office Action alleges that it would have been obvious to one of ordinary skill in the art at the time the invention was made to add the invention of Kellar to the invention of Vanfleteren. Applicant respectfully disagrees. Applicant submits that Vanfleteren is directed to plastic materials for connecting the two components. In contrast, Kellar discloses two distinct connecting methods. In particular, Kellar discloses in Figures 1A and 1B, that the active device wafers 110, 120 and 130 are connected by using dielectric layers 102 and 104, which may be high-temperature deformable

dielectric glue such as SILK and bonding adhesive such as borophosphosilicate glass. The electrical connections are accomplished through interwafer vias 106, and Kellar fails to disclose that the material used for the connections. *See, e.g.*, paragraph [0018].

In the second embodiment, Kellar discloses in Figure 2, a wafer bonding process between active device wafers is accomplished with metal patterns, for example, a 3D wafer-to-wafer vertical stack is produced. Kellar discloses that a metal bonding layer 108 is deposited on opposing surfaces of the bottom wafer 110 and the top wafer 120 to establish electrical connections between active IC-devices and to bond/connect the adjacent wafers. All the electrical connections between the two active devices 110 and 120 are made through metal lines or bumps and no adhesive or the like, is used to make the connection between the metallic bond pads. *See, e.g.*, paragraph [0023]. Applicant respectfully submits that Kellar discloses either bonding by plastics layers (in Figures 1A and 1B) or bonding by metal patterns (in Figure 2). Thus, Applicant submits that Kellar discloses using only one kind of connecting material, i.e. plastic adhesive or metal, between the two structures to be connected, and fails to disclose, or even suggest, a combination of electrically insulating material and electrically conducting material for the connections between the two structures. In view of the foregoing, Applicant respectfully submits that it would not have been obvious to one of ordinary skill in the art at the time the invention was made to combine the teaching of Kellar with the teaching of Vanfleteren because the two inventions are totally different from each other as explained above.

Also, Applicant respectfully submits that the Office's assertion of obviousness is lacking in *evidence* and one having ordinary skill in the art would not have envisioned such combination. Instead, the Office Action improperly relies on its own hindsight conjecture. For example, Kellar discloses metal patterns for connecting the circuitry on the two structures. In contrast, Vanfleteren discloses using plastics adhesives for connecting the two structures by electrically

conducting and by electrically insulating connections. Therefore, the Office Action improperly relies on hindsight in combining the two references and there is no motivation to combine the two references. Accordingly, Applicant respectfully submits that Vanfleteren and Kellar, either alone or in combination, fail to disclose, or even suggest, the claimed invention.

Regarding claims 2-8, these claims are dependent upon independent claim 1. If an independent claim is nonobvious under 35 U.S.C. 103, then any claim depending therefrom is nonobvious. In re Fine, 837 F.2d 1071 (Fed. Cir. 1988). Thus, since independent claim 1 should be allowable as discussed above, claims 2-8 should also be allowable at least by virtue of their dependency on independent claim 1. Moreover, these claims recite additional features which are not disclosed, or even suggested, by the cited references taken either alone or in combination.

In view of the foregoing, Applicant respectfully requests that the aforementioned obviousness rejection of claims 1-8 be withdrawn.

IV. THE OBVIOUSNESS REJECTION OF CLAIM 9

On page 11 of the Office Action, claim 9 was rejected under 35 U.S.C. § 103(a) as being unpatentable over U.S. Patent No. 6,555,414 to Vanfleteren *et al.* ("Vanfleteren") in view of U.S. Patent Application Publication No. 2004/0142540 to Kellar *et al.* ("Kellar") and further in view of U.S. Patent Application Publication No. 2003/0170936 to Christensen *et al.* ("Christensen"). This rejection is hereby respectfully traversed.

Applicant respectfully submits that the aforementioned obviousness rejection of claim 9 has become moot in view of the deficiencies of the primary references (i.e., Vanfleteren and Kellar) as discussed above with respect to independent claim 1. That is, claim 9 is dependent upon independent claim 1 and thus inherently incorporates all of the limitations of independent claim 1. Also, the secondary reference (i.e., Christensen) fails to disclose, or even suggest, the

deficiencies of the primary references as discussed above with respect to independent claim 1. Indeed, the Office Action does not even assert such. Thus, the combination of the secondary reference with the primary references also fails to disclose, or even suggest, the deficiencies of the primary references as discussed above with respect to independent claim 1. Accordingly, claim 9 should be allowable over the combination of the secondary reference with the primary references at least by virtue of its dependency on independent claim 1. Moreover, claim 9 recites additional features which are not disclosed, or even suggested, by the cited references taken either alone or in combination.

V. THE NEWLY ADDED CLAIM 21

Regarding newly added claim 21, Applicant respectfully submits that support for these claims may be found throughout the specification, and particularly on pages 4 and 5. Applicant respectfully submits that claim 21 should be allowable because the cited references either taken alone or in combination fail to disclose, or even suggest, “applying first patterned layer of the electrically non-conducting glass paste to the wafer surface side of one of the at least two processed semiconductor wafers and a second patterned layer of the electrically conducting glass paste on the wafer surface side of other of the at least two processed semiconductor wafers.” Accordingly, Applicant respectfully submits that the newly added claim 21 is allowable over cited references.

VI. CONCLUSION

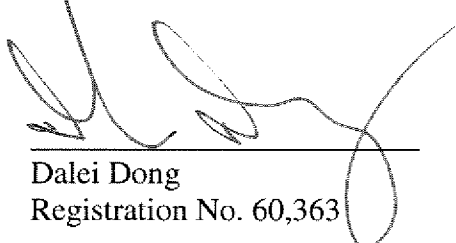
In view of the foregoing amendments and arguments, Applicant respectfully submits that this application is now in condition for allowance. If the Examiner believes that prosecution and allowance of the application will be expedited through an interview, whether personal or telephonic, the Examiner is invited to telephone the undersigned with any suggestions leading to the favorable disposition of the application.

It is believed that no fees are due for filing this Response. However, the Director is hereby authorized to treat any current or future reply, requiring a petition for an extension of time for its timely submission as incorporating a petition for extension of time for the appropriate length of time. Applicant also authorizes the Director to charge all required fees, fees under 37 C.F.R. §1.17, or all required extension of time fees, to the undersigned's Deposit Account No. 50-0206.

Respectfully submitted,

HUNTON & WILLIAMS LLP

By:



Dalei Dong
Registration No. 60,363

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Hunton & Williams LLP
1900 K Street, N.W.
Washington, D.C. 20006-1109
Telephone: (202) 955-1966
Facsimile: (202) 828-3763